EPA United States Environmental Protection Agency
Air and Radiation (6202J)
EPA 430-F-96-052
October 1996

APPLICATION PROFILE

Occupancy Sensor Control in Educational Spaces

EPA Green Lights
an ENERGY STAR program

University of Cincinnati, Lindner Hall

Cincinnati, Ohio

Director of Facilities Management: Jim Tucker

Contractor: In-House

Utility: Cincinnati Gas & Electric

PROJECT RESULTS

Energy Savings	36%
Installed Cost	$61,504
Rebate	$17,246
Simple Payback	1.9 years
Annual kWh Savings	374,063 kWh
Pollution Prevented	
CO_2	673,313 lbs/yr
SO_2	6,762 lbs/yr
No_x	2,144 lbs/yr

TYPICAL APPLICATIONS

- Classrooms
- Lecture Halls
- Faculty Offices
- Library Stacks
- Restrooms
- Study Rooms

OCCUPANCY SENSORS IN CLASSROOMS

For help in starting an occupancy sensor control program, contact a Green Lights Lighting Management Company Ally. For a list of these companies, call the Green Lights Hotline at 1-888-STAR-YES.

Automatic lighting controls are an essential component of an aggressive and profitable energy management program in educational facilities. Occupancy sensors minimize the unnecessary lighting of vacant spaces to save energy both during and after normal business hours. Occupancy sensors not only eliminate wasted lighting in infrequently or unpredictably occupied spaces during the day, but also prevent runaway lighting operation at night by eliminating reliance on occupants, cleaning or security crews to manually turn the lights off.

Occupancy sensors are suitable for a wide range of lighting applications. Sensors are most commonly mounted in switch locations, combinations of wall/corner surfaces, or ceiling mounted above the center of a space. Two motion-sensing strategies are prominent; passive-infrared and ultrasonic technologies. Infrared sensors detect body heat and require a direct "line-of-sight" to occupant motion. Ultrasonic sensors emit and receive ultra high-frequency sound waves well above the range of human hearing. They are better at recognizing motion hidden from the sensor's direct view. Some occupancy sensors are also equipped with an integral photocell to combine daylighting control with occupancy control.

The specification, placement and installation of occupancy sensors should be done by experienced, knowledgeable personnel. For a successful application, proper calibration is a must. Most sensors have adjustments for sensitivity to ensure that occupant motion is detected while filtering out extraneous signals, and for time delay to minimize excessive on/off cycling. Sensors equipped with photocells also have a light level setpoint adjustment to turn lights off in a room when adequate daylight is available. Trial installations are an excellent way to address many of these issues.

Benefits

- **Complimentary Technology:** Occupancy sensors make an excellent compliment to other lighting system upgrades. They are compatible with many technologies, and they offer additional HVAC savings and security advantages.
- **Peak Demand Period Opportunities:** Occupancy sensors are the only effective control strategy for reducing lighting run-time during business hours.
- **Immediate and Flexible Savings:** A properly commissioned occupancy sensor can immediately adapt to many workplace variables while remaining a low-maintenance component of lighting systems.

Issues

- **False Switching:** Occupant anxieties related to false switching can be addressed through careful specification of detection strategy, installation position, and post-installation commissioning.
- **Lamp Life:** Although fluorescent lamp life is reduced by frequent switching, the overall reduction in operating hours can extend the calender life for lamps.
- **Energy, Demand, and $ Savings:** Demand and energy rate structures must be considered to ensure that anticipated energy savings yield cost savings.
- **Occupant Education:** An occupant notification and education program is an essential component to foster user acceptance and ensure lasting savings.

CASE STUDY

Lindner Hall

The University of Cincinnati (UC) installed occupancy sensors throughout Lindner Hall, a classroom building, as part of their intelligent building plan. The goal of the plan was to reduce energy consumption and emissions while giving occupants greater control and more comfort. They chose occupancy sensors for Lindner Hall because they did not affect light output while the space is occupied, but reduced the total energy consumption.

One dual-technology sensor (with both passive infrared and ultrasonic technologies) was placed in each classroom. According to Jim Tucker, the Director of Facilities Management, Lindner Hall was the "logical trial site because of its high usage." The sensors are integrated into the direct digital control (DDC) system, which provides control of the HVAC system. In addition to controlling the lights, each room's sensor also cuts air flows to a minimum when the room is unoccupied. The DDC system has an override capability that allows the ventilation system to remain active based on scheduled room occupancy. The University of Cincinnati is pleased with the success of the occupancy sensor trial and would use the technology again because "it's an efficient and economical approach to providing a comfortable environment within our facilities."

Facility Information

87,230 square feet

675 seats in a lecture hall

1 occupancy sensor per lecture hall

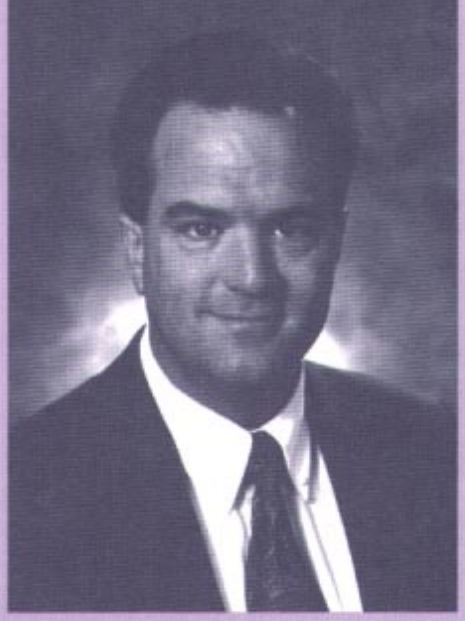
4,160 hours per year (base case)

2,660 hours per year (upgrade)

Equipment Information

Watt Stopper Dual-Technology, Ceiling-Mounted Sensor

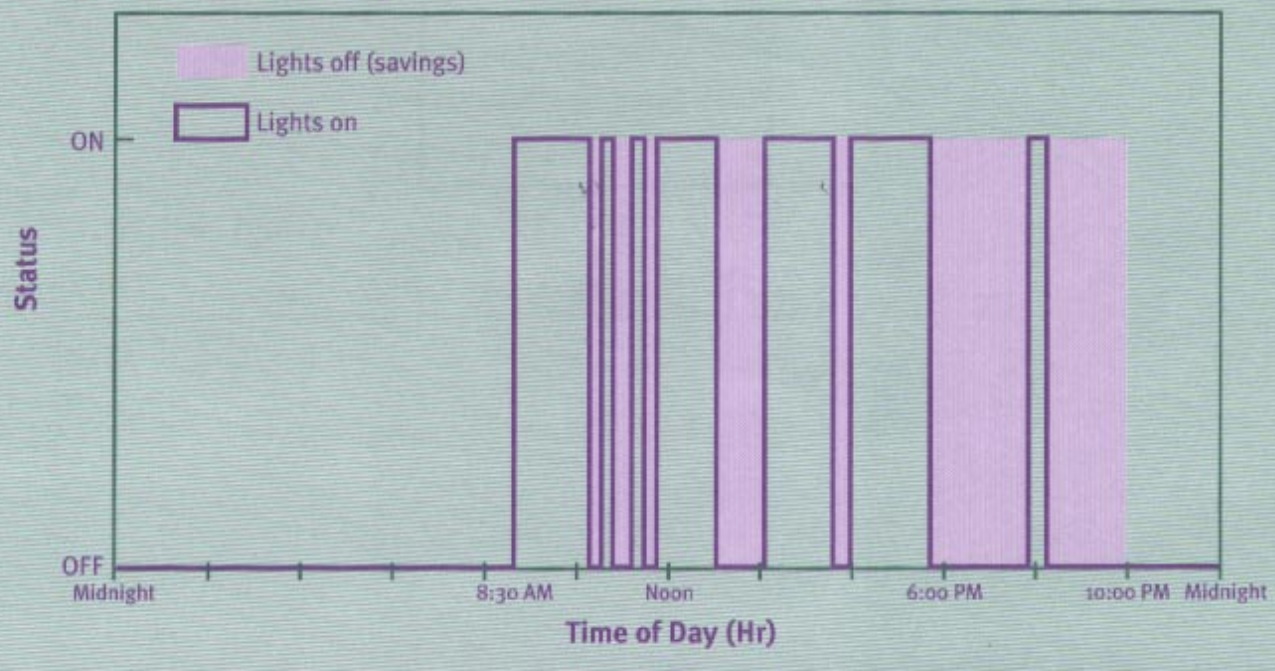
Watt Stopper Power and Slave Packs



"We knew that installing dual-technology occupancy sensors would enhance the energy efficiency we were already reaping through our DDC system."

- Jim Tucker
Director of Facilities Management

Comparison of Lighting Hours With and Without an Occupancy Sensor

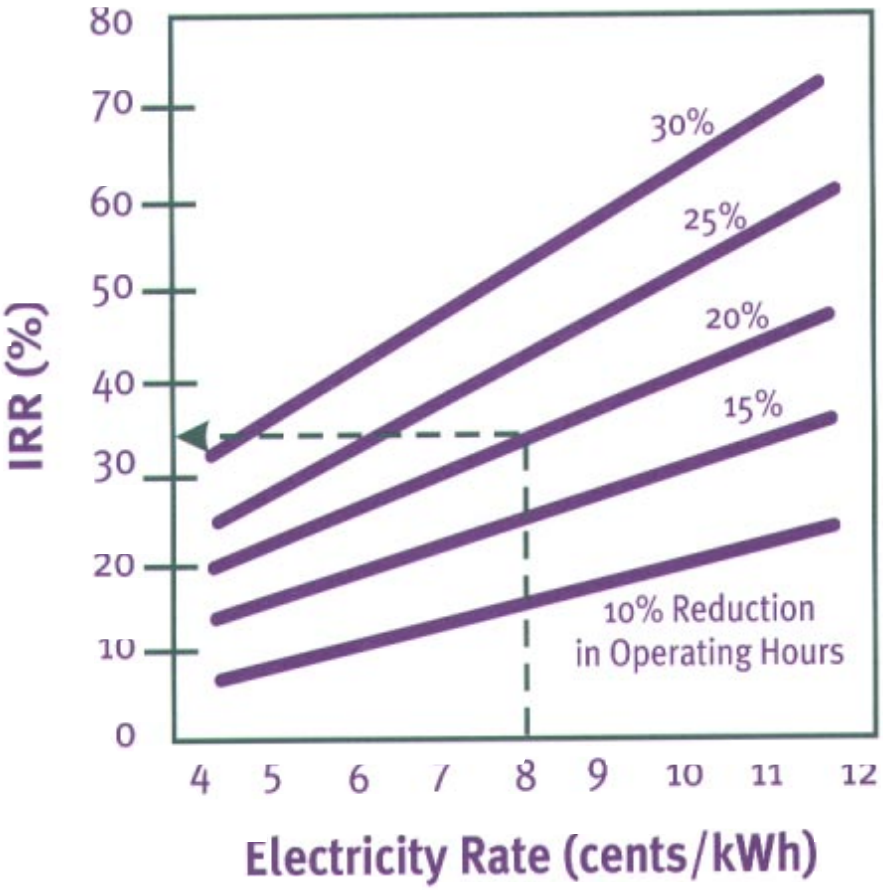


WILL IT WORK FOR YOU?

Use the following graph to estimate the cost effectiveness of installing occupancy sensors in your facility.

- Determine your average electricity rate. *For our example, the average electricity rate is 8 cents per kilowatt-hour.*
- Draw a vertical line from this point until it intersects the line that represents the estimated percentage reduction in lighting operating hours due to the installation of occupancy sensors. *For our example, it is estimated that a 20% reduction in operating hours will result due to the installation of occupancy sensors.*
- Draw a horizontal line from this point until it intersects the vertical axis that measures the after-tax internal rate of return. *Our sample upgrade earns an internal rate of return of 32 percent.*

OPEN AREA - CEILING-MOUNTED SENSOR



The Green Lights Program offers 2-day Lighting Upgrade Workshops, Application Profile brochures, and other technical support services to assist program participants in applying cost-saving lighting strategies. For more information, call the Green Lights Hotline at 1-888-STAR-YES.

Graph Assumptions

- Ceiling-mounted sensor controlling 10 fixtures, $190 installed cost.
- 3,500 hr/yr uncontrolled system operation.
- Fixtures are 3-lamp F32T8 with electronic ballasts @ 91 watts/fixture. Maintenance budget assumes a group maintenance program.